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(71) Applicant *(for all designated States except US)*: SANDVIK AKTIEBOLAG [SE/SE]; S-811 81 Sandviken (SE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: KAKAI, Isak [SE/SE]; Hyttgatan 13 A, S-811 30 Sandviken (SE).

(74) Agent: BENTON, Richard; Sandvik Aktiebolag, Intellectual Property, S-811 81 Sandviken (SE).

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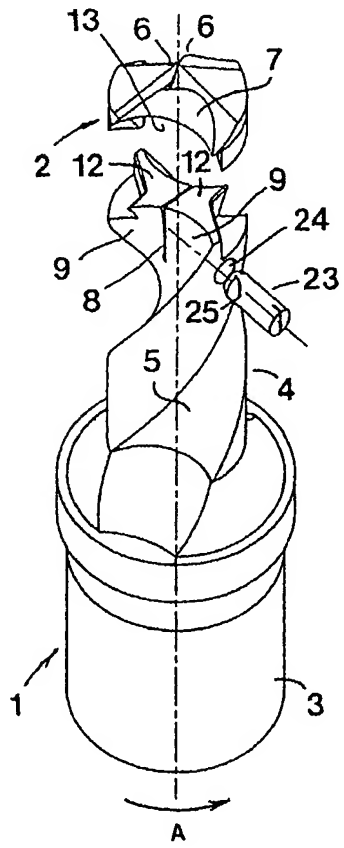
(54) Title: ROTATING TOOL FOR CHIP FORMING MACHINING WITH DETACHABLE TOOL HEAD



(57) Abstract: A rotating tool for chip removing machining comprises a rotatable holder part (1) and a detachable cutting part or loose top (2). In a front end portion of the holder part, one or more forwardly open slots (8) are formed, which separate a number of elastically deflectable wings (9). For centring and clamping of the loose top (2) on the holder part (1), a male/female coupling is arranged, comprising on the one hand a male-like projection (11) placed centrally on the front end of the holder part (1), which projection is intersected by the slots (8) and divided into a plurality of projection elements (12), and on the other hand a seat (13) formed in a rear end of the loose top (2) and located centrally in the same, into which seat the projection is insertable in an unloaded state. A tightening screw (23), accessible from the outside, is arranged to distance the projection elements (12) from each other when the male projection is inserted into the seat (13), more precisely with the purpose of pressing the external surfaces of the projection elements against internal surfaces in the seat (13), thereby clamping the loose top on the holder part.

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ROTATING TOOL FOR CHIP FORMING MACHINING WITH DETACHABLE TOOL HEAD

Technical Field of the Invention

This invention relates to a rotating tool, intended for chip removing or chip forming machining, which tool comprises two parts, viz. a rotatable holder part mountable in a machine, and a cutting part that is detachably connected to a front end of the holder part, whereby at least one forwardly open slot that separates two elastically deflectable wings is formed in a front end portion of the holder part.

Prior Art

Chip forming tools of the type that utilizes on the one hand a holder part or basic body, and on the other hand a separate, replaceable cutting part may in practice be of highly varying shapes and consist of, for instance, drilling tools, milling tools, such as shaft-type cutters and slot cutters, respectively, thread cutters, etc. The holder part usually consists of a long narrow, cylindrical shaft. In modern machine tools, the holder parts are so sophisticated and expensive that they – for economical reasons – cannot be integrated with the cutting part, which constitutes the wear part of the tool. In other words, it is profitable to form the actual cutting part as a separate, detachable unit (usually denominated "loose top" by those skilled in the art) that may be replaced after it has worn out, while the expensive holder part may be used for a longer period of time.

Previously known cutting tools of the type in question may be divided into two main categories, the first one of which being based on the intention of attaching the cutting part at the front end of the holder part by means of a short screw, which via a through hole in the cutting part is fastened in a female thread that extends axially in the holder part and ports at the front end thereof. Examples of such tools are described in US 5607263, DE 3448086 C2 and DE 29723558 U1. A disadvantage of this type of tool, however, is that cutting edges cannot be formed in the area of the front end of the cutting part. The consequence of this is that the cutting part can only be made for certain

types of milling (e.g. milling of T-slots), but not for drilling and other milling operations, respectively.

Another category of tools uses a drawbar, which is built into a normal axial, through bore within the holder part and which at the front end thereof includes means for clamping the cutting part. Examples of cutting tools having drawbars for the cutting parts are previously known from, for instance, EP 0911101, WO 96/34714 and WO 01/30524. A disadvantage of this type of tool, however, is that tightening of the drawbar takes place in the area at the rear end of the drawbar and the holder part. This means that the holder part has to be removed from the machine in question in connection with the exchange of the cutting part.

In US 5904455, a drilling tool is described, the holder part or shaft of which has a recess at the front end thereof, defined by two wings, for receipt of a cutting part. Furthermore, at the front-end portion of the holder part, a narrow slot is provided with the purpose of enabling elastic deflection of the wings. The two wings are formed with inwardly turned flank surfaces, which may be resiliently pressed up against contact surfaces on the sides of the cutting part, more precisely thanks to wedge surfaces being pressed into a V-track at the rear end of the cutting part. The wedge clamping effect is guaranteed by means of an axial screw within the holder part. A disadvantage of this tool, however, is that the cutting part, as well as the holder part, must be manufactured to great dimensional accuracy. Another disadvantage is that the tool requires disassembly from the appurtenant machine in order to enable manipulation of the screw in connection with exchange of the cutting part.

Aims and Features of the Invention

The present invention aims at obviating the above-mentioned disadvantages of previously known cutting tools of the type in question and at providing an improved cutting tool. Thus, a primary aim of the invention is to provide a cutting tool that on the one hand permits assembly and disassembly of the cutting unit without the holder part necessarily having to be removed from a machine, and on the other hand enables design

of cutting edges or application of cutting inserts at the front surface of the cutting part. An additional aim is to provide a tool, the two main parts of which, i.e., the cutting part and the holder part, respectively, may be separately mass-produced in a simple and cost-efficient way while guaranteeing a good centring of the cutting part in relation to the holder part. Among other things it should be possible to produce each of the two parts by means of simple machining operations and with a minimum of advanced grinding operations. Yet another aim of the invention is to provide a tool that minimizes the wear of the holder part, thereby securing long service life of the same.

According to the invention, at least the primary aim is attained by means of the features that are defined in the characterizing clause of claim 1. Preferred embodiments of the tool according to the invention are furthermore defined in the dependent claims.

Brief Description of the Appended Drawings

In the drawings:

Fig. 1 is an exploded view in perspective of a tool in the form of a drill, which in a known way includes on the one hand a holder part in the form of a shaft, and on the other hand a replaceable cutting part or loose top,

Fig. 2 is an analogous perspective view of only the holder part,

Fig. 3 is an enlarged perspective view seen from below of the loose top,

Fig. 4 is a planar view of the same loose top seen straight from below,

Fig. 5 is a perspective view corresponding to fig. 2 illustrating an alternative embodiment of a tool, whereby only the holder part of the tool is shown,

Fig. 6 is an enlarged end view of the holder part seen straight from above in fig. 5,

Fig. 7 is a perspective view of a holder part for a milling tool formed in accordance with the invention,

Fig. 8 is a perspective view seen from below of a loose top for the holder part according to fig. 7,

Fig. 9 is a partial longitudinal section through the upper portion of the holder part according to fig. 7, whereby a tightening screw is shown in connection with the holder part,

Fig. 10 is a cross-section through the holder part according to fig. 9, and

Fig. 11 is an enlarged perspective view of an alternative embodiment of a tightening screw for the tool according to the invention.

Detailed Description of Preferred Embodiments of the Invention

In figs. 1–4, a rotatable, chip removing tool is visualised in the form of a drill, which in the usual way includes a holder part, in its entirety designated 1, as well as a replaceable cutting part or loose top 2. The holder part 1 is formed with a comparatively thick rear base part 3, which is mountable in a machine, e.g. a multi-operation machine, as well as a thinner shaft 4 having two helicoidal, cross-section-wise curved chip channels 5. The front end or the tip of the loose top 2 is formed with cutting edges 6 of conventional or arbitrary type. Generally, the loose top has a circular outer contour shape with a diameter that is somewhat larger than the diameter of the shaft 4. However, in the loose top, concavely curved limiting surfaces 7 are formed, which connect to the curved shape of the chip channels 5.

The loose top 2 is entirely or partly manufactured from a hard, wear-resistant material, such as cemented carbide or the like, while the holder part consists of a material of greater elasticity, e.g. steel.

In the front, free end portion of the shaft 4, a forwardly open slot 8 is formed, which separates two elastically deflectable wings 9.

The actual shaft 4 ends at two shoulder surfaces 10, which preferably are plane and extend perpendicularly to the geometrical length or centre axis of the shaft. In accordance with the invention, a projection or projection-like body, in its entirety designated 11, which extends forwards (or upwards in the drawing) from said shoulder surfaces 10 is formed on the front end of the shaft. The projection 11 is divided into two reversed similar projection elements 12 by the existence of the slot 8, which is considerably deeper than the projection 11. The projection 11 is generally centrally placed and forms one of the parts, viz. the male part, in a male/female coupling, which furthermore includes a seat 13 formed in the rear end of the loose top 2 (see fig. 3). Said seat 13 is also centrally placed, more precisely in relation to the geometrical centre axis of the loose top. In the embodiment example according to figs. 1–4, the seat 13 is defined between two spaced-apart, diametrically opposed protrusions 14, which individually have on the one hand a plane end surface 15, and on the other hand two internal surfaces 16, 17 extending at an obtuse angle to each other. One of these surfaces, viz. the surface 16, is larger than the second one. A rear land 18 extends between the two protrusions 14. A concavely curved surface 20 extends having generally the same curved shape as the chip channel 5 between the external, convexly curved envelope surface 19 and the surface 17 of the individual protrusion 14.

The two pairs of internal surfaces 16, 17 on the loose top 2 interact with two pairs of analogous, external surfaces 21, 22 on the two male elements 12 of the male projection 11. The first-mentioned one of said surfaces 21, 22, is larger than the last-mentioned one and forms a driver surface that abuts against the surface 16 on the individual protrusion 14, whereby said driver surface 21 has the purpose of transferring the torque of the rotatable, driving shaft 4 to the loose top (see the arrow A, which indicates the direction of rotation of the drill).

As previously mentioned, the two wings 9 that are defined on both sides by the slot 8 are elastically deflectable. In this way, it is possible to separate the wings, thereby also

the two projection elements 12. In practice, the possibility for the projection elements to move is limited (e.g. to the range of 0,1–1,0 mm), but nevertheless, a marked separation of the free front ends of the projection elements can be achieved.

A clamping device is arranged with the purpose of achieving separation of the projection elements 12, which in the example according to figs. 1–4 consists of a screw 23. Said screw has a male thread that is fastenable in a female thread in a bore 24, extending radially from the outside of the shaft 4 up to the slot 8. Such a tightening screw 23 is arranged merely in connection with one of the wings 9, together with appurtenant projection elements 12. The gap 8 may be widened, and the two projection elements 12 distanced from each other by pressing the inner end or tip 25 of the screw up against the inside of the opposite wing 9 and tightening the screw using a suitable tensile force.

Function of the Tool according to the Invention

In an unloaded state, when the tightening screw 23 is not tightened, the two projection elements 12 assume a starting position near each other. In this state, the loose top 2 may be assembled on the drill shaft thanks to the interior surfaces 16, 17 having a certain loose fit being able to axially pass past the external surfaces 21, 22 on the projection elements 12, so that the support surfaces 15 on the protrusions 14 get into contact with the shoulder surfaces 10 on the drill shaft 4. In the next step, the tightening screw 23 is tightened with a certain torque, whereby the projection elements 12 are separated and clamped with the external surfaces 21, 22 thereof up against the corresponding surfaces 16, 17 on the inside of the protrusions 14. The loose top may be clamped in a reliable way with no risk of being cracked or deformed by fastening the screw with a predetermined, well-judged torque.

When the loose top 2 after a certain operating time has worn out and is to be exchanged, the simple measure of loosening the screw 23 a short distance is taken, whereby the tensile force ceases and the two projection elements 12, through the inherent elasticity of the material in the drill shaft (usually steel), return to the starting positions thereof

near each other. In this state, the loose top may be removed by hand and replaced with a new loose top, which in turn is fixed in the way described above.

A primary advantage of the invention is that the loose top may be assembled and disassembled in a very simple and fast way without the holder part 1 having to be removed from the appurtenant machine. Furthermore, the holder part 1 as well as the loose top or cutting part 2 may be mass-produced in an efficient and inexpensive way by means of simple machining operations.

The plane surfaces 16, 17 on the insides of the protrusions 14 and the interacting, plane surfaces 21, 22 on the projection elements 12 may extend substantially parallel to the geometrical centre axis of the tool. However, it is also feasible to incline the same surfaces, more precisely so that the surfaces 21, 22 diverge somewhat in relation to each other in the direction forwards from the shoulder surfaces 10, at the same time as the internal surfaces 16, 17 converge somewhat in the direction backwards.

Furthermore, it should be observed that the bore 24 for the tightening screw 23 is located near the actual free end of the drill shaft such as this is defined by the shoulder surfaces 10, although at a certain, moderate distance from the same. This means that the screw will be pressed against the wing 9 opposite the bore at a point approximately halfway between the bottom and mouth of the slot 8.

The two surfaces 16, 17 of the protrusions 14 form wedge-like material portions that in a male-like way engage in the female-like recesses that together are delimited by the surfaces 21, 22 of the projection elements 12.

In figs. 5 and 6, an alternative embodiment is shown, according to which the outsides of the two projection elements 12 in a male-like way engage in female-like recesses in the protrusions of a loose top. In figs. 5 and 6, only the holder part of the tool is shown, while the appurtenant loose top is omitted. In this embodiment, the projection elements 12 are formed with outsides or envelope surfaces 26, which generally are of a rotationally symmetrical shape, e.g. cylindrical or conical (in the last-mentioned case,

the cone surface should diverge in the direction forwards). In the centre of each envelope surface 26, a projecting ridge or cam 27 is formed, which is arranged to engage a countersink having the same shape in the inside of an individual protrusion (corresponding to the protrusion 14 in figs. 1–4) on a loose top (not shown). It is to advantage if the cams 27 are softly rounded, as is shown in figs. 5 and 6. When the loose top is applied on the holder part, the cams 27 serve as drivers, which transfer the requisite torque from the driving holder part to the clamped loose top.

Reference is now made to figs. 7–10, which illustrate the invention applied to a milling tool. Also in this case, the tool includes a holder part 1 and a loose top or cutting part 2 (which in a conventional way may include cutting inserts or cutting edges, which are not shown in the drawing). In this case, the front portion of the holder part 1 includes not only a first slot, but also a plurality of other slots. More precisely, the front end portion of the holder part is formed with four slots that extend perpendicularly to each other and define four similar projection elements 12, 12', 12", 12"'. Furthermore, the projection 11, formed collectively by the four projection elements, is formed with a rotationally symmetrical, cylindrical or conical basic shape. This means that the individual projection elements 12, 12', 12", 12"' become cross-section-wise circular sector-formed. If the projection shape is conical, the conicity should diverge in the direction forwards.

In order to transfer torque between the holder part and the loose top, countersinks 28 are formed in the shoulder surfaces 10 of the holder part for receipt of a pair of shoulders 29 having an analogous shape on the loose top 2.

In connection with one of the four projection elements, viz. the projection element 12, a threaded bore 24 for a tightening screw 23 is arranged. The tip 25 of the tightening screw is, in this case, cone-shaped. More precisely, the tip has the shape of a truncated cone.

The bore 24 is located at a certain, limited distance from the shoulder surface 10 (see fig. 9), which means that the same is included in one of four wings 9, spaced-apart by

means of the slots 8, in the extension of which wings the projection elements 12, 12', 12", 12"' extend. In the area of the central intersection point between the wings 9, the bore 24 ends in a conical bottom 30, which is delimited by partially conical part surfaces in the inner edge portions of the wings that meet in the central intersection point. Thus, in the wing appurtenant to the projection element 12", a genuinely conical countersink is formed into which the outermost portion of the tip 25 of the screw may be pressed. In the opposite edge portions of the wings of the projection elements 12', and 12"', curved surfaces are formed, the shape of which is determined by the conical shape of the tip 25 of the screw 23. When the screw is tightened, not only the diametrically opposed projection elements 12, 12" will be separated, but also the two other projection elements 12', 12"', which are mutually opposite. In other words, all four projection elements will become distanced from the centre of the tool when the screw is tightened. This results in the rotationally symmetrically shaped envelope surfaces 31 of the projection elements 12, 12', 12", 12"' being fixedly pressed up against an internal, rotationally symmetrically shaped surface 32, which defines a central seat 13 in the loose top 2. The surfaces 31, 32 may be either cylindrical or slightly conical. In the last-mentioned case, the cone surface 31 should diverge in the direction forwards from the shoulder surface 10, while the surface 32 converges in the direction backwards from the inside of the seat 13 up against the ring-shaped, surrounding contact surface 15.

Reference being made to fig. 10, it should be pointed out that the bore 24 extends in a bisector-like way halfway between the two plane surfaces (lacking reference designation), which together with the rotationally symmetrical envelope surface 31 define the projection element 12.

A notable feature of the tool according to figs. 7–10 is that the tip 25 of the screw engages in a conically shaped countersink in the wing (belonging to the projection element 12"), which is opposite the bore 24 of the screw. In this way, the screw secures the two wings against deformation as a consequence of possible torsion forces, which tend to laterally displace or apply torsion to the wings in relation to each other.

The same type of torsion securing may of course also be applied in the two embodiments according to figs. 1–4 and 5–6, respectively. In this case, a shallow countersink is formed in the wing 9 that is opposite the screw bore 24, whereby the tip 25 of the screw may engage the countersink in order to counteract distortion.

In fig. 11, an alternative screw 23 is shown for an embodiment having a plurality of slots according to figs. 7–10. In this case, the screw includes a front, sleeve-like part 33, which is formed with two plane flank surfaces 34, which extend obliquely rearwards from a straight ridge 35, which includes two diminutive lips on both sides of an intermediate groove formation. Said ridge may be pressed against a linear edge at a wing opposite the screw (cf. the wing 12" in fig. 10) at the same time as the two inclined surfaces 34 are pressed against plane limiting surfaces of nearby wings (cf. the wings 12', 12''' in fig. 10). The actual screw 23 has a front, cylindrical portion that is inserted into the sleeve portion and enables rotation of the screw without the sleeve portion being set in rotation.

Feasible Modifications of the Invention

The invention is not merely limited to the embodiments described above and illustrated in the drawings. Thus, other means than screws may be used as clamping devices for separation of the projection elements, e.g. wedge elements. Furthermore, the invention may be applied also to other tools than drills and milling cutters.

List of References

1. Holder part
2. Cutting part or loose top
3. Base part
4. Drill shaft
5. Chip channel
6. Cutting edges
7. Curved surface
8. Slot
9. Wings
10. Shoulder surface
11. Projection
12. Projection element
13. Seat
14. Protrusion
15. Support surface
16. Limiting surface
17. Limiting surface
18. Land
19. Envelope surface
20. Curved surface
21. Limiting surface
22. Limiting surface
23. Tightening screw
24. Bore
25. Screw tip
26. Envelope surface
27. Cam
28. Recess
29. Shoulder
30. Cone bottom

31. Envelope surface
32. Seat delimiting surface
33. Sleeve portion
34. Flank surface
35. Ridge

Claims

1. Rotating tool for chip removing machining, comprising two parts, viz. a rotatable holder part (1) mountable in a machine and a cutting part (2) that is detachably connected to a front end of the holder part, whereby at least one forwardly open slot (8) that separates two elastically deflectable wings (9) is formed in a front end portion of the holder part, c h a r a c t e r i z e d in, that a male/female coupling is arranged for centring and clamping of the cutting part (2) on the holder part (1), which coupling comprises on the one hand a male-like projection (11) placed centrally on the front end of the holder part, which projection is intersected by the slot (8) and divided into a plurality of projection elements (12), and on the other hand a seat (13) formed in a rear end of the cutting part (2) and located centrally in the same, into which seat the projection (11) is insertable in an unloaded state, and that a clamping device(23), accessible from the outside, is arranged to distance said projection elements (12) from each other when the male projection is inserted into the seat, more precisely with the purpose of pressing external surfaces (21, 22; 26, 31) on the projection elements against internal surfaces (16, 17;32) in the seat (13).

2. Tool according to claim 1, c h a r a c t e r i z e d in, that the clamping device consists of a screw (23) placed in a bore (24) that extends substantially radially from the outside of the holder part (1) up to the slot (8).

3. Tool according to claims 1 or 2, c h a r a c t e r i z e d in, that not only a first slot is formed in the front portion of the holder part (1), but also one or more second slots, which together with the first slot define a plurality of projection elements (12, 12', 12", 12'").

4. Tool according to claim 3, c h a r a c t e r i z e d in, that four slots, extending perpendicularly to each other and defining four similar projection elements (12, 12', 12", 12'") are formed in the front portion of the holder part.

5. Tool according to any one of claims 2–4, c h a r a c t e r i z e d in, that the screw (23) and the bore (24) therefor extend in a bisector-like way halfway between two plane surfaces of a first projection element (12) and are directed towards a second, diametrically opposite projection element (12"), against which the screw (23) is pressable.

6. Tool according to any one of claims 2–5, c h a r a c t e r i z e d in, that a rotationally symmetrically shaped tip (25) on the tightening screw is arranged to engage a likewise rotationally symmetrically shaped countersink in the second projection element (12"), against which the screw is pressable.

7. Tool according to any one of the preceding claims, c h a r a c t e r i z e d in, that the external surface or envelope surface (31) on the projection (11) of the holder part, as well as the interacting internal surface (32) in the seat (13) of the cutting part (2), are of a rotationally symmetrical shape.

8. Tool according to claim 7, c h a r a c t e r i z e d in, that the envelope surface (31) of the projection (11) is at least partially conical, more precisely in such a way that the conicity of the surface converges in the direction axially rearwards, and that the internal surface (32) of the seat (13) is likewise at least partially conical, more precisely in such a way that the conicity of the surface converges in the direction axially rearwards.

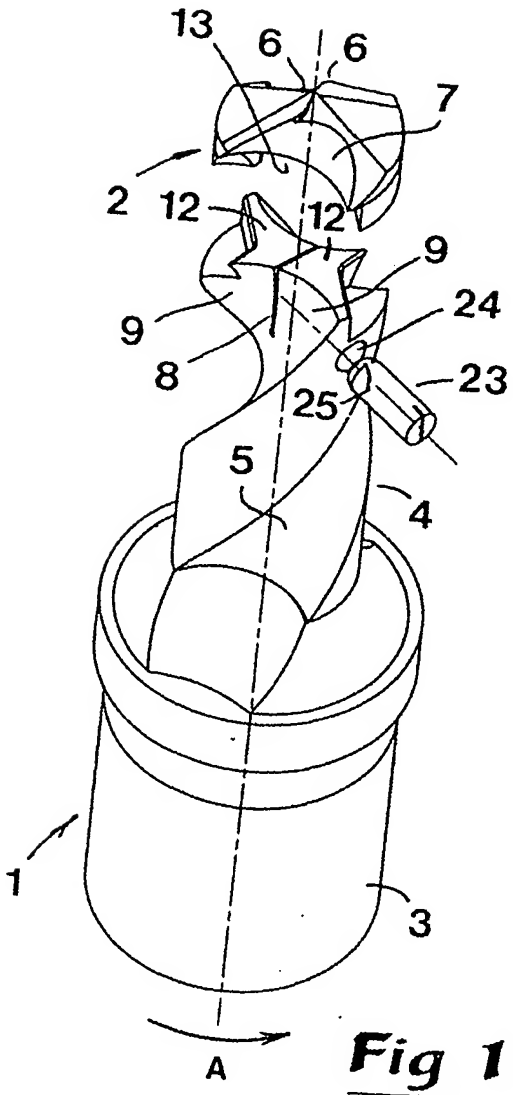

Fig 1

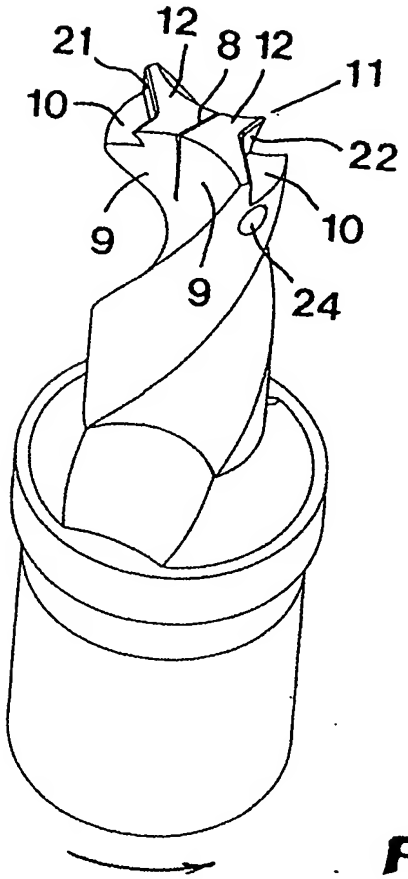

Fig 2

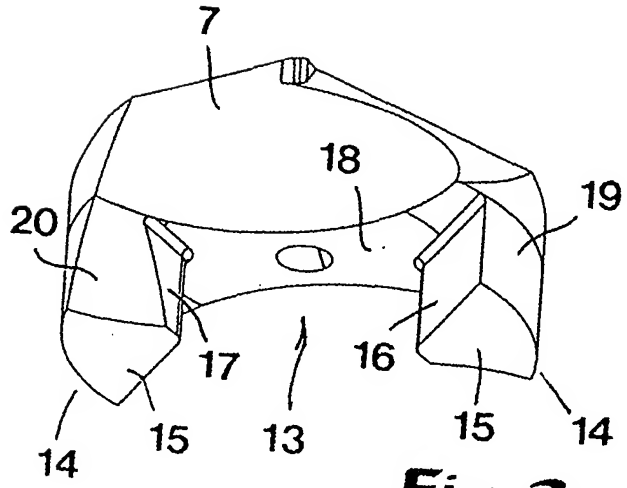

Fig 3

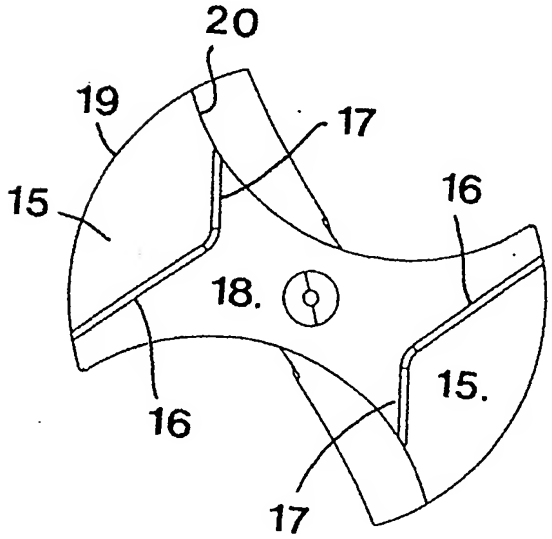

Fig 4

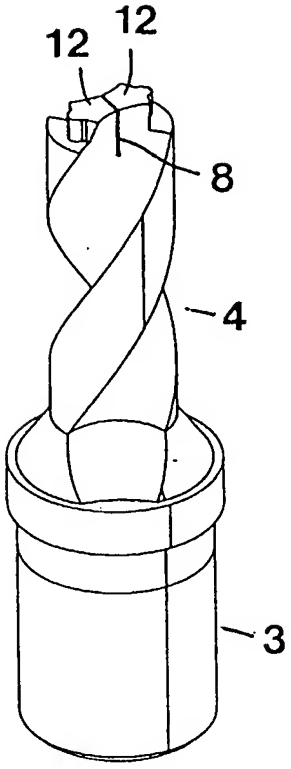

Fig 5

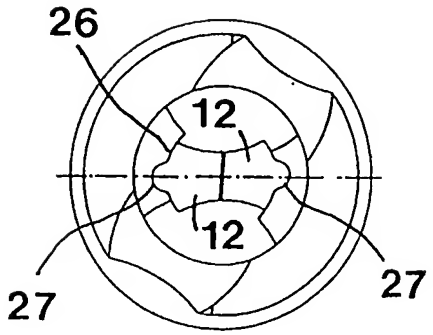

Fig 6

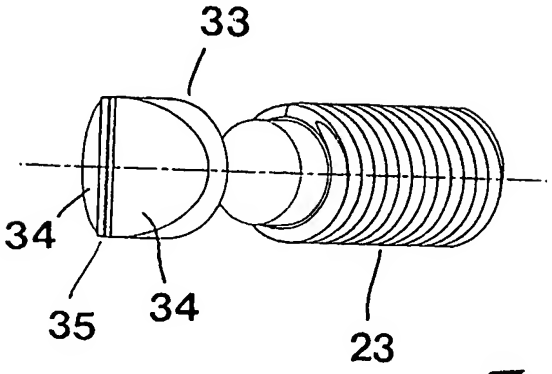

Fig 11

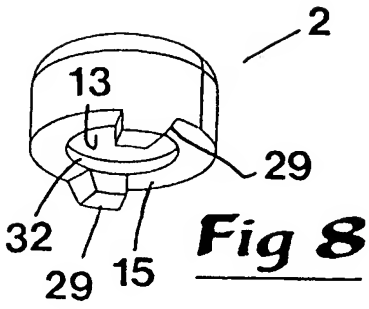

Fig 8

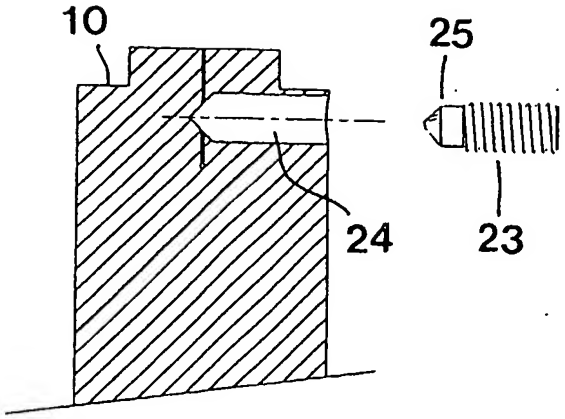

Fig 9

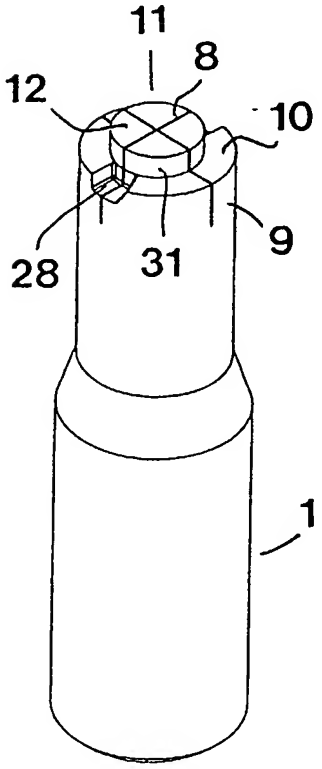

Fig 7

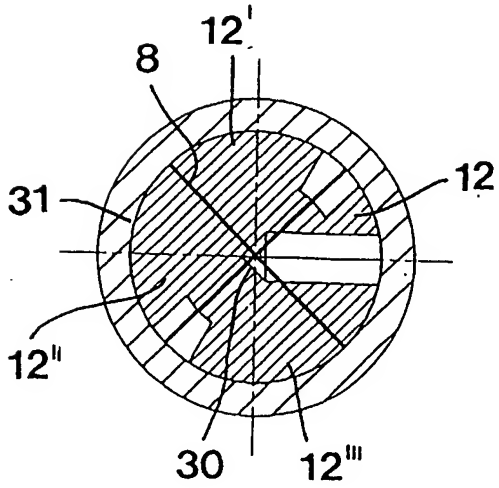

Fig 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/01814

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B23B 51/00 // B23C 5/20
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B23B, B23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	DATABASE WPI Week 200241 Derwent Publications Ltd., London, GB; Class P54, AN 2002-379470 & JP 2002113606 A (MITSUBISHI MATERIALS CORP) 16 April 2002 (2002-04-16) abstract; figures 1-12 ---	1-8
P,X	DE 20204848 U1 (JOHNE & CO. PRÄZISIONSWERKZEUGE GMBH), 11 July 2002 (11.07.02), page 12, line 9 - page 13, line 3, figures 2a,b, abstract ---	1-8
P,X	US 2002/0057951 A1 (BENGT SILVER), 16 May 2002 (16.05.02), figures 2-6, abstract ---	1-8

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 January 2003	21-01-2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM	Authorized officer Fredrik Strand/MP

INTERNATIONAL SEARCH REPORT

International application No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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